Prepared by:

ROGERS ENERGY COMPLEX

ACTIVE ASH BASIN

INACTIVE UNITS 1-4 BASIN

INACTIVE UNIT 5 BASIN

CLOSURE PLAN

OCTOBER 10, 2016

Certified by:

Amec Foster Wheeler Environment & Infrastructure, Inc.

2801 Yorkmont Road Suite # 100

Charlotte, North Carolina 28208

License Number: F-1253

CLIFF_CLOSE_PLN

Rev. 0

Duke Energy Carolinas, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundments at the Rogers Energy Complex (Cliffside Steam Station) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the Active Ash Basin and Inactive Units 1-4 Basin, located in Cleveland County, North Carolina, and Inactive Unit 5 Basin, located in Rutherford County, North Carolina, (collectively, Ash Basins), on property owned by Duke Energy. This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. A narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the CCR units;
3. A description of the final cover system designed pursuant to 40 C.F.R. § 257.102(d), a description of the methods and procedures to be used to install the final cover, and a discussion of how the final cover system will achieve the performance standards specified in 40 C.F.R. § 257.102(d);
4. An estimate of the in-place CCR inventory requiring closure;
5. An estimate of the largest area of the CCR units requiring a final cover;
6. A closure schedule; and
7. A written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps necessary to close the Ash Basins at Cliffside Steam Station consistent with recognized and generally accepted good engineering practices. Closure is designed to reduce the need for long-term maintenance, control the post-closure infiltration of liquids into the in-place CCR materials, and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

The Inactive Units 1-4 Basin will be closed through the removal of CCR, and the closure will be performed pursuant to 40 C.F.R. § 257.102(c). CCR will be removed as described in the following section.

Although, on May 18, 2016, the North Carolina Department of Environmental Quality (NCDEQ) ranked the Active Ash Basin and the Inactive Unit 5 Basin “intermediate-risk,” which would require them to be dewatered and excavated pursuant to the North Carolina Coal Ash Management Act of 2014, as amended (CAMA), Duke Energy is in the process of establishing the permanent replacement water supplies required under N.C.G.S. § 130A-309.211(c1) and performing the applicable dam safety repair work required under Dam Safety Order 16-01 issued by the state of North Carolina pursuant to the North Carolina Dam Safety Law of 1967, specifically N.C.G.S. § 143-215.32. Pursuant to N.C.G.S. § 130A-309.213(d)(1), upon Duke

Energy's completion of these tasks within the required time frame set forth in CAMA, NCDEQ must classify the Active Ash Basin and the Inactive Unit 5 Basin as low-risk, which will allow closure either pursuant to 40 C.F.R. § 257.102(c) or (d). Although CAMA charges NCDEQ with making the final determination regarding closure method, because science supports closure of the Active Ash Basin and the Inactive Unit 5 Basin by leaving the CCR in place, Duke Energy contemplates that the Active Ash Basin and the Inactive Unit 5 Basin will be closed pursuant to the requirements of 40 C.F.R. § 257.102(d).

The method to close the CCR units in place will include: removal and treatment of the bulk water/free liquids; interstitial/pore dewatering (as needed) and treatment; stabilization of remaining CCR materials sufficient to support the final cover system; grading of in-place CCR materials to promote positive drainage (no ponding) and prevent sloughing or movement of the final cover system; installation of a final cover system, including stormwater management controls; partial breaching/lowering of the dam; and post-closure groundwater monitoring and cover system maintenance. The final cover system will be designed to minimize infiltration; and erosion in order to meet, or exceed, the requirements of the final cover system specified in 40 C.F.R. § 257.102(d)(3)(i). Typically, this involves the installation of a low permeability barrier layer and a vegetated soil cover to protect the barrier layer.

2 CCR REMOVAL AND DECONTAMINATION

The procedures to remove CCR from Inactive Units 1-4 Basin include dewatering and utilizing appropriate equipment and methods to excavate and move the CCR to an on-site permitted landfill. Dewatering will include removal of bulk water/free liquids and interstitial/pore water (as needed) to allow for safe excavation.

The existing embankments will be breached and regraded pursuant to a North Carolina Department of Environmental Quality (NCDEQ) Dam Safety permit approval. This breach is intended to promote free drainage of storm water from the closure area.

There may be some areas, primarily located around the perimeter of the Active Ash Basin and the Inactive Unit 5 Basin, where closure-by-removal is selected in order to enhance surface drainage and/or to allow for development of future plant infrastructure or transmission. In-place CCR in those areas will typically be dewatered (if needed), excavated, and then consolidated (placed) into the remaining portion of the basin, which will be graded and closed-in-place pursuant to 40 C.F.R. § 257.102(d).

Existing appurtenant structures, such as ditches, culverts, and miscellaneous piping, will be decontaminated and abandoned in place, or removed and disposed in a permitted disposal facility, or placed in a beneficial use facility identified at the time of closure. Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 FINAL COVER REQUIREMENTS

The final cover system for in-place closure of the Active Ash Basin and the Inactive Unit 5 Basin will be designed pursuant to 40 C.F.R. § 257.102(d). Closure of the Active Ash Basin and the Inactive Unit 5 Basin will be conducted in a manner that controls, minimizes, or eliminates, to the maximum extent feasible, the post-closure infiltration of liquids into the CCR and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

The final cover system being considered is a composite (soil and geosynthetics) cover system consisting of (from top to bottom):

- A six-inch layer of soil that is capable of sustaining native plant growth;
- An 18-inch thick protective soil cover layer;
- A geocomposite drainage layer or non-woven geotextile; and
- A 40-mil thick linear low-density polyethylene geomembrane barrier.

Alternative final cover systems are also under evaluation that would meet, or exceed, the requirements specified in 40 C.F.R. § 257.102(d)(3)(ii), which make use of the latest developments in final cover technology. The final cover system will serve to reduce erosion and post-closure maintenance. Various stormwater control measures (e.g., diversion berms, channels, downslope pipes, and/or downchutes) will convey surface run-off from the cover, then to sediment basins (as appropriate), prior to discharge. The design of the stormwater conveyances will include armoring and energy dissipation measures, as necessary, to control erosion and reduce maintenance and repairs.

The final cover system, with an equivalent (or lower) permeability of any bottom liner system or natural subsoils present, or a permeability no greater than $1x10^{-5}$ centimeters/second, will be constructed and maintained to minimize the infiltration of precipitation. By minimizing infiltration, the final cover will reduce leachate generation. The final cover system will be graded to preclude the probability of future impoundment of water, sediment, or slurry.

The Active Ash Basin and the Inactive Unit 5 Basin will be closed in a manner resulting in stable slopes that prevent the sloughing or movement of the final cover system. The grades of the final cover system will be generally slight, sufficient to promote run-off while reducing the potential for sloughing. Instability potential (sliding or sloughing) will be further reduced through the selection and use of cover system materials that have adequate drainage properties and sufficient internal and interface shear strengths. Construction quality assurance procedures will be completed to confirm conformance of the installed final cover system to the design.

Upon commencement of closure of the Active Ash Basin and the Inactive Unit 5 Basin, final closure is anticipated to be completed in the shortest amount of time consistent with recognized

and generally accepted good engineering practices. Section 6, Closure Schedule, of this Closure Plan describes the estimated time frames.

3.1 FINAL COVER SYSTEM

Pursuant to 40 C.F.R. § 257.102(d)(3)(i)(A) through (D), the final cover system will be designed and constructed to meet, at a minimum, the following criteria:

(A) The permeability of the final cover system will be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} centimeters/second, whichever is less.

The final cover system options being considered for the Active Ash Basin and the Inactive Unit 5 Basin will meet or exceed this criteria. The geomembrane by itself results in a lower effective infiltration rate than the 18 inches of $1x10^{-5}$ centimeters/second soil standard.

(B) The infiltration of liquids through the CCR units will be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

The geomembrane component in the final cover system results in equivalent or better infiltration performance than 18 inches of earthen material. The proposed protective cover (18 inches) and vegetative layer soil will be obtained from local borrow sites and/or portions of the dams and dikes that will be breached or lowered during closure. The gradation of the soil used in the cover will be such that it does not damage the geomembrane, provides drainage, resists erosion, and supports plant growth.

(C) The erosion of the final cover system will be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

The materials proposed for the vegetative support layer in the composite cover system option, or the protective cover component of an alternate final cover system, will provide equivalent or better performance than a six-inch-thick erosion layer. In addition, and prior to the completion of closure, stormwater run-off and wastewaters generated from areas outside the Active Ash Basin's and the Inactive Unit 5 Basin's drainage catchment (which had previously been routed through the basin when they were active) will be permanently diverted for treatment (as needed) and discharge at other locations within the site.

(D) The disruption of the integrity of the final cover system will be minimized through a design that accommodates settling and subsidence.

The materials proposed for the final cover systems will accommodate the amount of settlement and subsidence that is anticipated to be encountered during construction and post-closure. In addition, the cover grades and stormwater conveyance system grades will be designed to accommodate settlement during construction and post-closure care.

The methods and procedures used to install the final cover will include:

1. Completing necessary field characterizations and design analyses;
2. Obtaining necessary federal, state, and local permits;
3. Preparing bid documents and selecting a qualified contractor;
4. Mobilizing;
5. Installing erosion and sediment control measures;
6. Removing and treating (as needed) the bulk water/free liquid;
7. Decontaminating and abandoning in place, or removing the appurtenant structures within the CCR units;
8. Clearing and grubbing;
9. Constructing laydown areas and access roads;
10. Interstitial/pore dewatering and treatment (as needed);
11. Grading CCR materials to achieve design cover system subgrade elevations;
12. Installing the cover system and associated stormwater management controls;
13. Stabilizing the site with appropriate vegetation and final erosion and sediment control measures;
14. Breaching of the dam; and
15. Commencing post-closure maintenance and monitoring of the site.

3.2 DRAINAGE AND STABILIZATION

Bulk water/free liquids will be removed from the Active Ash Basin during the initial phases of construction. Interstitial/pore water may be removed and treated during construction as needed to provide a workable surface for final cover system installation. With the diversion of wastewater and the stormwater discharged to the basin from other locations on the site, the volume of interstitial/pore water within the basin is expected to further decline over time. The dam will be breached following the final phase of cover system installation. Combined, these measures (diversion of wastewater and stormwater, bulk dewatering, selective interstitial/pore dewatering, cover system installation, and dam breaching) will stabilize the CCR materials sufficiently to support the final cover system.

4 ESTIMATE OF IN-PLACE CCR INVENTORY

The volumes of CCR present in the Ash Basins were calculated and are presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volumes are the estimated inventory of CCR that will be open (and require closure) at one time, and the estimates are based on bathymetric surveys, historical topography and soil borings as of April 2015. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basins.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
Inactive Unit 1-4 Basin	353,000
Inactive Unit 5 Basin	1,960,000
Active Ash Basin	4,131,000
Estimated Total	**6,444,000**

5 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

Closure of the Active Ash Basin and Inactive Unit 5 Basin will be accomplished by leaving CCR in place pursuant to 40 C.F.R. § 257.102(d). The largest area of the Active Ash Basin and Inactive Unit 5 Basin that will be open (and requiring a final cover) at one time is estimated to be a combined 112 acres (78 and 34 acres, respectively).

6 CLOSURE SCHEDULE

Closure of the Inactive Units 1-4 Basin was initiated in 2015 pursuant to 40 C.F.R. § 257.102(e) and is anticipated to be completed within five years of the commencement of closure pursuant to 40 C.F.R. § 257.102(f)(1)(ii), i.e., by 2020.

Closure of the Active Ash Basin and Inactive Unit 5 Basin will be initiated pursuant to 40 C.F.R. § 257.102(e) and is anticipated to be completed within seven years of the commencement of closure pursuant to 40 C.F.R. § 257.102(f)(1)(ii) and 40 C.F.R. § 257.102(f)(2). The closure time frame includes a two-year time extension beyond the time specified in 40 C.F.R. § 257.102(f)(1)(ii) on the basis that the anticipated time required to close the Active Ash Basin and Inactive Unit 5 Basin will need to be lengthened due to:

- The Active Ash Basin and Inactive Unit 5 Basin being larger than 40 acres (estimated 86 acres for the Active Ash Basin and 46 acres for the Unit 5 Inactive Basin);
- The amount of material needed to close the Active Ash Basin and Inactive Unit 5 Basin (greater than 362,000 cubic yards of protective soil cover and vegetative cover material);
- The volume of CCR (greater than 1.1 million cubic yards will need to be excavated and placed as grading fill);
- The volume of bulk water/free liquids to dewater (more than 290 million gallons);
- The surrounding geology (shallow rock resulting in limited soil volume per given area, limited availability of soil meeting the permeability requirements outlined in the CCR Rule, need to process soils to remove rock that could damage geomembrane, etc.); and
- The time required, after the removal of bulk liquids, for the surface of the basin to stabilize to the point that personnel and equipment can safely access the impoundment. Given the site-specific geometry and physical characteristics of the CCR in the impoundment, the rate at which the materials will drain will likely be slow and variable. As a result, installation of instrumentation and monitoring equipment may be necessary in some instances to ensure subgrade stability is adequate, and other measures may need to be employed to stabilize

the surface of the impoundment (possibly including closely-spaced well points, deep wells, trenches, etc.) in a timely manner.

The completed demonstration establishing why it is not feasible to complete closure of the Active Ash Basin and Inactive Unit 5 Basin within the five-year time frame due to factors beyond the facility's control will be prepared and placed in the facility's operating record prior to the end of any two-year period pursuant to 40 C.F.R. § 257.102(f)(2).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from NCDEQ and the U.S. Army Corps of Engineers. Preliminary time frames of anticipated closure activities for the Ash Basins are included below in Table 2. We estimate that all of the closure activities for the Active Ash Basin and Inactive Unit 5 Basin will be completed by 2026.

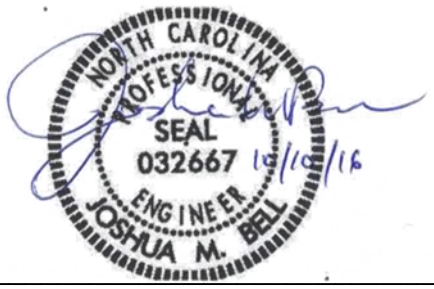
Table 2. Estimated Time Frames for Closure Activities

Closure Activity	**Time Frame (years)***	
	Inactive Units 1-4 Basin	**Active Ash Basin and Inactive Unit 5 Basin**
NCDEQ Closure Plan Approval	1	1
NCDEQ Permitting Approvals (NPDES, E&SC, Air)	1	1
Dewatering and Stabilization	2.5	4.5
NCDEQ Dam Decommissioning Approval	0.5	0.5
CCR Grading and/or Excavation	1	2
Final Cover Installation	-	3.5

*Estimated closure activity time frames may include some overlap.

7 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Joshua M. Bell, being a registered Professional Engineer in the state of North Carolina, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this written Closure Plan dated October 10, 2016, was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared in accordance with recognized and generally accepted good engineering practices.



SIGNATURE _____ DATE_____

Prepared for:
DUKE ENERGY

Rogers Energy Complex CCP Landfill
573 Duke Power Road
Mooresboro, NC 28114

ROGERS ENERGY COMPLEX
(Cliffside Steam Station)
COAL COMBUSTION PRODUCTS (CCP) LANDFILL

CLOSURE PLAN

OCTOBER 2016

Prepared by:

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CLIFF_CLOSE_LDFL_PLN

1.0 INTRODUCTION

This Closure Plan was prepared for the Rogers Energy Complex (REC) Coal Combustion Products (CCP) Landfill. This Closure Plan was prepared in accordance with 40 C.F.R. Part 257, Subpart D and is consistent with the requirements of 40 C.F.R. § 257.102(b) for closure of coal combustion residuals landfills. The information contained in this Closure Plan will be used to assist Duke Energy Carolinas, LLC (Duke Energy) in the closure of active waste units. The REC CCP Landfill is owned and operated by Duke Energy. The landfill is located in Rutherford County, North Carolina on Duke property, south of the REC Plant. Duke Energy must obtain a written certification from a qualified professional engineer, licensed in the state in which the project work is conducted, that this written Closure Plan and any amendments thereto meet the requirements of 40 C.F.R. § 257.102.

2.0 CLOSURE PLAN

2.1 Overview of Closure Approach

The purpose of the Closure Plan is to outline the steps necessary to close the landfill phases consistent with recognized and generally accepted good engineering practices. Closure is designed to minimize the need for long-term maintenance and to control the post-closure release of contaminants. The facility will be closed in accordance with the requirements of 40 C.F.R. § 257.102. Closure will occur within the time frames set out in 40 C.F.R. § 257.102(f). This Closure Plan may be amended in accordance with the requirements of 40 C.F.R. § 257.102(b)(3).

The final cover system has been designed to minimize the amount of storm water infiltration into the landfill and to resist erosive forces. The final cover system consists of an erosion layer, protective soil layer, drainage layer, and barrier layer.

2.2 Estimated Maximum Inventory of CCR

The current landfill design provides approximately 13,343,000 cubic yards of gross capacity as measured from the top of the protective cover soil to the top of final cover.

2.3 Largest Area Requiring Cover System

The construction of the landfill will occur in 5 phases. Phases I and II are 23 and 15 acres, respectively. Thusly, Phases I and II would be the largest closure to date, covering an area of approximately 38 acres.

2.4 Closure Performance Standard

2.4.1 Final Cover System

The cover system has been designed to reduce infiltration into the landfill and to resist erosion. The permeability of the least permeable layer is 1×10^{-13} cm/sec. This is equal to or less than the permeability of the bottom liner system and no greater than $1 \times 10{-}5$ cm/sec.

The final cover system for the closed phase will be certified by a qualified professional engineer as being designed in accordance with the requirements of 40 C.F.R. § 257.102.

With the type of waste that has been landfilled and the controlled nature of the fill placement, no decomposition of the waste material is expected, therefore minimal, if any, settlement is expected. Due to the high allowable strain of the geomembrane and the stable nature of the waste, the final cover system will accommodate any differential settlement that may occur in the waste during the post closure care period.

The proposed final cover system will consist of the following from top to bottom and will be placed over the existing intermediate soil cover:

- a 6-inch thick vegetated erosion layer;
- an 18-inch thick protective soil layer;
- a geocomposite drainage layer;
- a 40-mil thick, double-sided textured linear low density polyethylene (LLDPE) geomembrane; and
- a geocomposite gas collection layer (if determined necessary).

The proposed final cover system shall be installed by methods and procedures that will not damage the geosynthetic layers. The following methods and procedures shall be implemented.

Geosynthetic Subgrade: The subgrade shall be inspected and approved by the Engineer prior to placement of the barrier layer. The subgrade shall be smooth and free of rocks and debris that may damage the LLDPE geomembrane.

LLDPE Geomembrane: The LLDPE geomembrane shall be inspected and approved by the Engineer prior to deployment. The LLDPE geomembrane shall be installed in accordance with the quality control procedures outlined in the project specifications and under the direction of the Engineer and per manufacturer's guidelines.

Geocomposite Drainage Layer: The drainage geocomposite shall be inspected and approved by the Engineer prior to deployment which shall only occur after acceptance of the LLDPE barrier layer by the Engineer. The geocomposite shall be installed in accordance with the quality control procedures outlined in the project specifications and under the direction of the Engineer and per manufacturer's guidelines.

Protective Soil Layer: The protective soil layer shall be installed over the geocomposite which shall be compacted utilizing only low-ground pressure equipment approved by the Engineer. Protective soils and shall meet the requirements of the project specifications and shall be approved by the Engineer prior to installation. No protective soil shall be installed prior to acceptance of the geocomposite. Depth of the infiltration layer shall be confirmed in the field by the Engineer.

Vegetated Erosion Layer: The vegetated erosion layer shall be installed and compacted only utilizing low-ground pressure equipment after acceptance of the protective soil layer

by the Engineer. The vegetated erosion layer soils shall meet the requirements of the project specifications and shall be approved by the engineer prior to installation. The depth of the vegetated erosion layer shall be confirmed in the field by the engineer. Vegetation shall be established on the vegetated erosion layer by methods outlined in the project specifications and approved by the Engineer. Appropriate erosion controls shall be utilized to protect sloped areas and promote vegetation.

2.4.2 Alternate Final Cover System

No alternative final cover is being considered.

2.4.3 Performance Standards

Closure of the facility will be conducted in a manner that minimizes the need for further maintenance and controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, the post-closure escape of uncontrolled leachate, surface runoff, or waste decomposition products to the groundwater, surface water, or the atmosphere.

The final cover system consisting of a vegetated soil layer with run-on and run-off controls will minimize the need for post-closure maintenance. The final slopes of the landfill will promote runoff. Diversion berms and downslope pipes will convey surface runoff to sediment basins designed for removal of sediment prior to discharge. A hardy stand of vegetation will be established and, along with the diversion berms and storm water conveyance channels, will minimize erosion of the final cover system.

A low-permeability final cover system will be constructed and maintained that minimizes the infiltration of precipitation into the waste mass. By minimizing infiltration, the final cover will minimize leachate generation.

The final slopes of the landfill will not be less than five percent to prevent ponding.

The CCR unit will be closed in a manner that provides for slope stability to prevent the sloughing or movement of the final cover system. In order to maintain stable slopes for the final cover, the internal and interface friction angle of all the components must be greater than the slope angle by a margin called the factor of safety. Since the maximum regulatory slopes are 3 to 1 (horizontal to vertical), only materials with friction angles greater than 26.6^{o} will be used, providing a minimum factor of safety of 1.5. To ensure the stability of the vegetative support layer in the final cover system, adequate drainage must be provided to prevent the soil from becoming saturated and subject to seepage forces.

An analysis was also performed to demonstrate the stability of proposed cap section during seismic conditions. An acceptable factor of safety is 1.0 or greater to guard against slope failure. The analysis was performed in accordance with the requirements of 40 C.F.R. § 257.63 and the seismic factor of safety was found to be greater than 1.0.

The final cover system will be finished within six months following the beginning of closure construction unless otherwise approved. If more than six months are necessary, steps to prevent threats to human health and the environment from the unclosed landfill unit will be undertaken.

2.5 Schedule

In accordance with 40 C.F.R. § 257.102(e), the facility will begin closure activities within 30 days after the known final receipt of waste, or if the landfill has remaining capacity and there is a reasonable likelihood that the landfill will receive additional wastes, no later than two years after the most recent receipt of wastes. Contractor mobilization will occur during the initial 30-day period after last known receipt of waste.

In accordance with 40 C.F.R. § 257.102(f)(1)], closure of the CCR unit must be completed within six months of commencing closure activities, or by an approved extension deadline.

In accordance with 40 C.F.R. § 257.102(g), no later than the date on which closure of the CCR unit is initiated, prepare a notification of intent to close the unit, which includes the certification by a qualified professional engineer for the design of the final cover system required by § 257.102(d)(3)(iii).

In accordance with 40 C.F.R. § 257.102(h), within 30 days following completion of closure of the CCR unit, Duke Energy shall record a notation on the deed to the landfill property stating that the property has been used as a landfill and its use is restricted under the Post-Closure Plan and the post-closure care requirements as provided by 40 C.F.R. § 257.104(d)(1)(iii).

Within 30 days of recording the notation, Duke Energy shall prepare a notification stating that that the notation has been recorded and placed it into the facility's operating record. Pursuant to 40 C.F.R. § 257.106(d), Duke Energy shall send to the appropriate regulatory agency the notification of intent to close, notification of closure completion, and notification of deed notation, within 30 days of placing each such notification in the operating record.

An expected schedule for closure activities is as follows:

Time	Activity
Prior to last receipt of waste	Permitting, detailed closure design and contractor selection
Initial 30 days after last receipt of waste	Mobilization of contractor
Months 0-1 after beginning construction	Grading /preparation of intermediate cover
Months 1-4 after beginning construction	Placement of soil layer and/or geomembrane liner, and soil protective layers
Months 4-5 after beginning construction	Installation of diversion berms and downslope pipes
Months 5-6 after beginning construction	Seed, fertilize and mulch

3.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Kenton J. Yang, being a registered Professional Engineer, in accordance with the North Carolina Professional Engineer's Registration do hereby certify to the best of my knowledge, information, and belief, that the information contained in this report dated October 10, 2016 was conducted in accordance with the requirements of 40 C.F.R. § 257.102, is true and correct, and has been prepared in accordance with recognized and generally accepted good engineering practices.

Prepared by:

DUKE ENERGY

ALLEN STEAM STATION

ACTIVE ASH BASIN

RETIRED ASH BASIN

CLOSURE PLAN

OCTOBER 10, 2016

Certified by:

AECOM

1600 Perimeter Park Drive, Suite 400

Morrisville, NC 27560

Engineering Firm License Number - **C-2243**

ALL_CLOSE_PLN

Rev. 0

Duke Energy Carolinas, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundments at the Allen Steam Station (Allen) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). URS Corporation – North Carolina (AECOM) was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the Active Ash Basin and Retired Ash Basin (collectively, Ash Basins) located in Gaston County, North Carolina, on property owned by Duke Energy. This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

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1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps necessary to close the Ash Basins consistent with recognized and generally accepted good engineering practices. Closure is designed to reduce the need for long-term maintenance, control the post-closure infiltration of liquids into the in-place CCR materials, and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

Although, on May 18, 2016, the North Carolina Department of Environmental Quality (NCDEQ) ranked the Ash Basins “intermediate-risk,” which would require them to be dewatered and excavated pursuant to the North Carolina Coal Ash Management Act of 2014, as amended (CAMA), Duke Energy is in the process of establishing the permanent replacement water supplies required under N.C.G.S. § 130A-309.211(c1) and performing the applicable dam safety repair work required under Dam Safety Order 16-01 issued by the state of North Carolina pursuant to the North Carolina Dam Safety Law of 1967, specifically N.C.G.S. § 143-215.32. Pursuant to N.C.G.S. § 130A-309.213(d)(1), upon Duke Energy’s completion of these tasks within the required time frame set forth in CAMA, NCDEQ must classify the Ash Basins as low-risk, which will allow closure either pursuant to 40 C.F.R. § 257.102(c) or (d). Although CAMA charges NCDEQ with making the final determination regarding closure method, because science supports closure of the Ash Basins by leaving the CCR in place, Duke Energy

contemplates that the Ash Basins will be closed in accordance with the requirements of 40 C.F.R. § 257.102(d).

The method to close the Ash Basins in place will include: removal and treatment of the bulk water/free liquids; interstitial/pore dewatering (as needed) and treatment; stabilization of remaining CCR materials sufficient to support the final cover system; grading of in-place CCR materials to promote positive drainage (no ponding) and prevent sloughing or movement of the final cover system; installation of a final cover system, including stormwater management controls; and post-closure groundwater monitoring and cover system maintenance. Typically, this involves the installation of a low permeability barrier layer and a vegetated soil cover to protect the barrier layer.

2 CCR REMOVAL AND DECONTAMINATION

There may be some areas, primarily located around the perimeter of the Ash Basins, where closure-by-removal is selected in order to enhance surface drainage and/or to allow for development of future plant infrastructure or transmission. In-place CCR from those areas will typically be dewatered (if needed), excavated, and consolidated (placed) into the remaining portion of the basin, which will be graded and closed-in-place pursuant to 40 C.F.R. § 257.102(d).

Existing appurtenant structures, such as ditches, culverts and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed in a permitted disposal facility, or removed and placed in a beneficial use facility identified at the time of closure. Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 FINAL COVER REQUIREMENTS

The final cover system for in-place closure of the Ash Basins will be designed pursuant to 40 C.F.R. § 257.102(d). Closure of the Ash Basins will be conducted in a manner that controls, minimizes, or eliminates, to the maximum extent feasible, the post-closure infiltration of liquids into the CCR and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

The final cover system being considered is a composite (soil and geosynthetics) cover system consisting of (from top to bottom):

- A six-inch layer of soil that is capable of sustaining native plant growth;
- An 18-inch thick protective soil cover layer;

- A geocomposite drainage layer or non-woven geotextile; and
- A 40-mil thick linear low-density polyethylene geomembrane barrier.

Alternative final cover systems are also under evaluation that would meet, or exceed, the requirements specified in 40 C.F.R. § 257.102(d)(3)(ii), which make use of the latest developments in final cover technology. The final cover system will serve to reduce erosion and post-closure maintenance. Various stormwater control measures (e.g., diversion berms, channels, downslope pipes, and/or downchutes) will convey surface run-off from the cover, then to sediment basins (as appropriate), prior to discharge until the site is stabilized by vegetation. The design of the stormwater conveyances will include armoring and energy dissipation measures, as necessary, to control erosion and reduce maintenance and repairs.

The final cover system, with an equivalent (or lower) permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 18 inches of $1x10^{-5}$ centimeters/second, will be constructed and maintained to minimize the infiltration of precipitation. By minimizing infiltration, the final cover will reduce leachate generation. The final cover system will be graded to preclude the probability of future impoundment of water, sediment, or slurry.

The Ash Basins will be closed in a manner resulting in stable slopes that prevent the sloughing or movement of the final cover system. The grades of the final cover system will be generally slight, sufficient to promote run-off while reducing the potential for sloughing. Instability potential (sliding or sloughing) is further reduced through the selection and use of cover system materials that have adequate drainage properties and sufficient internal and interface shear strengths. Construction quality assurance procedures will be completed to confirm conformance of the installed final cover system to the design.

Upon commencement of closure of the Ash Basins, final closure is anticipated to be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices. Section 6, Closure Schedule, of this Closure Plan describes estimated time frames.

3.1 FINAL COVER SYSTEM

Pursuant to 40 C.F.R. § 257.102(d)(3)(i)(A) through (D), the final cover system will be designed and constructed to meet, at a minimum, the following criteria:

(A) The permeability of the final cover system will be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} centimeters/second, whichever is less.

The final cover system options being considered for the Ash Basins will meet or exceed this criteria. The geomembrane by itself results in a lower effective infiltration rate than the required 18 inches of $1x10^{-5}$ centimeters/second soil.

(B) The infiltration of liquids through the CCR units will be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

The geomembrane component of the final cover system results in equivalent or better infiltration performance than 18 inches of earthen material. The proposed protective cover (18 inches) and vegetative layer soil will be obtained from local borrow sites and/or portions of the dams and dikes that will be breached during closure. The gradation of the soil used in the cover will be such that it does not damage the geomembrane, provides drainage, resists erosion, and supports plant growth.

(C) The erosion of the final cover system will be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

The materials proposed for the vegetative support layer in the composite cover system option, or the protective cover component of an alternative final cover system, will provide equivalent or better performance than a six-inch-thick erosion layer. In addition, and prior to the completion of closure, stormwater run-off and wastewaters generated from areas outside the Ash Basins' drainage catchment (which had previously been routed through the basins when they were active) will be permanently diverted for treatment (as needed) and discharge at other locations within the site.

(D) The disruption of the integrity of the final cover system will be minimized through a design that accommodates settling and subsidence.

The materials proposed for the final cover systems will accommodate the amount of settlement and subsidence that is anticipated to be encountered during construction and post-closure. In addition, the cover grades and stormwater conveyance system grades will be designed to accommodate settlement during construction and post-closure care.

The methods and procedures used to install the final cover will include:

1. Completing necessary field characterizations and design analyses;
2. Obtaining necessary federal, state, and local permits;
3. Preparing bid documents and selecting a qualified contractor;
4. Mobilizing;
5. Installing erosion and sediment control measures;
6. Removing and treating (as needed) the bulk water/free liquid;
7. Decontaminating and abandoning in place, or removing the appurtenant structures within the CCR units;
8. Clearing and grubbing;
9. Constructing laydown areas and access roads;
10. Interstitial/pore dewatering and treatment (as needed);
11. Grading CCR materials to achieve design cover system subgrade elevations;
12. Installing the cover system and associated stormwater management controls;
13. Stabilizing the site with appropriate vegetation and final erosion and sediment control measures; and

14. Commencing post-closure maintenance and monitoring of the site.

3.2 DRAINAGE AND STABILIZATION

Bulk water/free liquids will be removed from the Ash Basins during the initial phases of construction. Interstitial/pore water may be removed and treated during construction (as needed) to provide a workable surface for final cover system installation. With the diversion of wastewater and the stormwater discharged to the basin from other locations on the site, the volume of interstitial/pore water within the basin is expected to further decline over time. Combined, these measures (diversion of wastewater and stormwater, bulk dewatering, selective interstitial/pore dewatering, and cover system installation) will stabilize the CCR materials sufficiently to support the final cover system.

4 ESTIMATE OF IN-PLACE CCR INVENTORY

The volumes of CCR present in the Ash Basins were calculated and are presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volumes are the estimated inventory of CCR that will be open (and require closure) at one time, and the estimates are based on bathymetric surveys, historical topography, and soil borings as of February 2015. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basins.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
Active Ash Basin	8,699,607
Retired Ash Basin	4,290,000
Estimated Total	**12,989,607**

5 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

Closure of the Ash Basins will be accomplished by leaving CCR in place pursuant to 40 C.F.R. § 257.102(d). The largest area of the CCR units that will be open (and requiring a final cover) at one time is estimated to be 262 acres.

6 CLOSURE SCHEDULE

Closure of the Ash Basins will be initiated pursuant to 40 C.F.R. § 257.102(e) and is anticipated to be completed within nine years of the commencement of closure activities. The closure time frame includes two two-year time extensions beyond the time specified in 40 C.F.R. § 257.102(f)(1)(ii) on the basis that the anticipated time required to close the Ash Basins will need to be lengthened due to:

- The Ash Basins being larger than 40 acres (estimated 169 acres for the Active Ash Basin and 93 acres for the Retired Ash Basin);

- The amount of material needed to close the Ash Basins (greater than 975,000 cubic yards of protective soil cover and vegetation cover material will need to be imported to the site);
- The volume of CCR (greater than 1.6 million cubic yards will need to be excavated and placed as grading fill);
- The volume of bulk water/free liquids to dewater (more than 64 million gallons);
- The time required, after the removal of bulk liquids, for the surface of the basin to stabilize to the point that personnel and equipment can safely access the impoundment. Given the site-specific geometry and physical characteristics of the CCR in the impoundment, the rate at which the materials will drain will likely be slow and variable. As a result, installation of instrumentation and monitoring equipment may be necessary in some instances to ensure subgrade stability is adequate, and other measures may need to be employed to stabilize the surface of the impoundment (possibly including closely-spaced well points, deep wells, trenches, etc.) in a timely manner.

The completed demonstration establishing why it is not feasible to complete closure of the Ash Basins within the five-year time frame due to factors beyond the facility's control will be prepared and placed in the facility's operating record prior to the end of any two-year period pursuant to 40 C.F.R. § 257.102(f)(2).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from NCDEQ and the U.S. Army Corps of Engineers. Preliminary time frames of anticipated closure activities for the Ash Basins are included below in Table 2. We estimate that all of the closure activities for the Ash Basins will be completed by 2028.

Table 2. Estimated Time Frames for Closure Activities

Closure Activity	Time Frame (years)*
NCDEQ Closure Plan Approval	1
NCDEQ Permitting Approvals (NDPES, E&SC, Air)	1
Dewatering and Stabilization	2
CCR Grading	2
NCDEQ Dam Decommissioning Approval	0.5
Final Cover Installation	6.5

*Estimated closure activity time frames may include some overlap.

7 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Jay D Mokotoff, being a registered Professional Engineer in the state of North Carolina, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this written Closure Plan dated October 10, 2016, was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared pursuant to recognized and generally accepted good engineering practices.

SIGNATURE _____ DATE 10/10/16

Prepared for:
DUKE ENERGY

Allen Steam Station
253 Plant Allen Road
Belmont, North Carolina 28012

ALLEN STEAM STATION
RETIRED ASH BASIN (RAB) ASH LANDFILL – PHASE 1

CLOSURE PLAN

OCTOBER 10, 2016

Prepared by:
S&ME
9751 SOUTHERN PINE BLVD
CHARLOTTE, NORTH CAROLINA 28273
PHONE: 704.523.4726
FAX: 704. 525.3953
S&ME Project No.: 7235-15-035

CLOSURE PLAN

1.0 INTRODUCTION

This Closure Plan was prepared for the Allen Steam Station (ALNSS) – Retired Ash Basin (RAB) Ash Landfill. This Closure Plan was prepared in accordance with 40 C.F.R. Part 257, Subpart D and is consistent with the requirements of 40 C.F.R. § 257.102(b) for closure of coal combustion residuals landfills. The information contained in this Closure Plan will be used to assist Duke Energy Carolinas, LLC (Duke Energy) in the closure of active waste units. The ALNSS Ash Landfill is owned and operated by Duke Energy. The landfill is located in Gaston County, North Carolina on Duke property, adjacent to the Catawba River, south of the steam station and approximately 0.5 miles southeast of the intersection of Plant Allen Road and South Point Road (NC Highway 273). Duke Energy must obtain a written certification from a qualified professional engineer, licensed in the state in which the project work is conducted, that this written Closure Plan and any amendments thereto meet the requirements of 40 C.F.R. § 257.102.

2.0 CLOSURE PLAN

2.1 Overview of Closure Approach

The purpose of the Closure Plan is to outline the steps necessary to close the landfill phases consistent with recognized and generally accepted good engineering practices. Closure is designed to minimize the need for long-term maintenance and to control the post-closure release of contaminants. The facility will be closed in accordance with the requirements of 40 C.F.R. § 257.102. Closure will occur within the time frames set out in 40 C.F.R. § 257.102(f). This Closure Plan may be amended in accordance with the requirements of 40 C.F.R. § 257.102(b)(3).

2.2 Estimated Maximum Inventory of CCR

The design of constructed cells (Phase 1, Cells 1 & 2) provides approximately 2,082,500 cubic yards of airspace available for waste placement (including operational soils).

2.3 Largest Area Requiring Cover System

The Phase 1 area of approximately 25 acres is currently the largest area that will need to be capped.

2.4 Closure Performance Standard

2.4.1 Final Cover System

The cover system has been designed to reduce infiltration into the landfill and to resist erosion. The permeability of the least permeable layer is on the order of $1 \times 10{-}12$ cm/sec. This is equal to or less than the permeability of the bottom liner system and no greater than $1 \times 10{-}5$ cm/sec.

The final cover system for the closed phase will be certified by a qualified professional engineer as being designed in accordance with the requirements of 40 C.F.R. § 257.102.

With the type of waste that has been landfilled and the controlled nature of the fill placement, no decomposition of the waste material is expected, therefore minimum, if any, settlement is expected. Due to the high allowable strain of the geomembrane and the stable nature of the waste, the final cover system will accommodate any differential settlement that may occur in the waste during the post closure care period.

The proposed final cover system will consist of the following from top to bottom and will be placed over the existing intermediate soil cover:

- a 6-inch thick vegetated erosion layer;
- an 18-inch thick soil barrier;
- a geocomposite drainage layer; and
- a 40-mil thick double-sided textured linear low density polyethylene (LLDPE) geomembrane.

2.4.2 Alternate Final Cover System

An alternate final cover system may be utilized and will consist of the following from top to bottom and will be placed over the existing intermediate soil cover:

- a 6-inch thick vegetated erosion layer;
- an 18-inch thick soil barrier;
- an 8 oz/sy non-woven geotextile for the alternate cover system); and
- a 50-mil LLDPE structured geomembrane for the alternate cover system).

2.4.3 Performance Standards

Closure of the facility will be conducted in a manner that minimizes the need for further maintenance and controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, the post-closure escape of uncontrolled leachate, surface runoff, or waste decomposition products to the groundwater, surface water, or the atmosphere.

The final cover system consisting of a vegetated soil layer with run-on and run-off controls will minimize the need for post-closure maintenance. The final slopes of the landfill will promote runoff. Diversion berms and downslope pipes will convey surface runoff to sediment basins designed for removal of sediment prior to discharge. A hardy stand of vegetation will be established and, along with the diversion berms and storm water conveyance channels, will minimize erosion of the final cover system.

A low-permeability final cover system will be constructed and maintained that minimizes the infiltration of precipitation into the waste mass. By minimizing infiltration, the final cover will minimize leachate generation.

The final slopes of the landfill will not be less than five percent to prevent ponding.

The CCR unit will be closed in a manner that provides for slope stability to prevent the sloughing or movement of the final cover system. In order to maintain stable slopes for the final cover, the internal and interface friction angle of all the components must be greater than the slope angle by a margin called the factor of safety. An analysis was performed to demonstrate the stability of proposed cap section during static conditions. An acceptable factor of safety is 1.5 or greater to guard against slope failure. To ensure the stability of the vegetative support layer in the final cover system, adequate drainage must be provided to prevent the soil from becoming saturated and subject to seepage forces.

An analysis was also performed to demonstrate the stability of proposed cap section during seismic conditions. An acceptable factor of safety is 1.0 or greater to guard against slope failure. The analysis was performed in accordance with the requirements of 40 C.F.R. § 257.63 and the seismic factor of safety was found to be greater than 1.0.

The final cover system will be finished within six months following the beginning of closure construction unless otherwise approved. If more than six months are necessary, steps to prevent threats to human health and the environment from the unclosed landfill unit will be undertaken.

2.5 Schedule

In accordance with 40 C.F.R. § 257.102(e), the facility will begin closure activities within 30 days after the known final receipt of waste, or if the landfill has remaining capacity and there is a reasonable likelihood that the landfill will receive additional wastes, no later than two years after the most recent receipt of wastes. Contractor mobilization will occur during the initial 30-day period after last known receipt of waste.

In accordance with 40 C.F.R. § 257.102(g), no later than the date on which closure of the CCR unit is initiated, Duke Energy shall prepare a notification of intent to close the unit, which includes the certification by a qualified professional engineer for the design of the final cover system required by § 257.102(d)(3)(iii).

In accordance with 40 C.F.R. § 257.102(h), within 30 days following completion of closure of the CCR unit, Duke Energy shall record a notation on the deed to the landfill property stating that the property has been used as a landfill and its use is restricted under the Post-Closure Plan and the post-closure care requirements as provided by 40 C.F.R. § 257.104(d)(1)(iii).

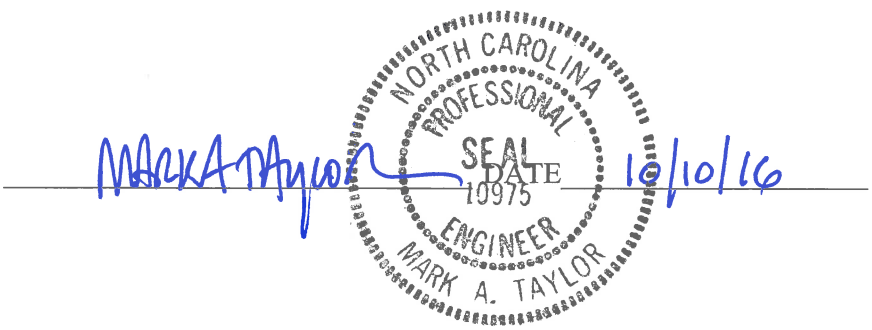
Within 30 days of recording the notation, Duke Energy shall prepare a notification stating that that the notation has been recorded and placed it into the facility's operating record. Pursuant to 40 C.F.R. § 257.106(d), Duke Energy shall send to the appropriate regulatory agency the notification of intent to close, notification of closure completion, and notification of deed notation, within 30 days of placing each such notification in the operating record.

An expected schedule for closure activities is as follows:

Time	Activity
Prior to last receipt of waste	Permitting, detailed closure design and contractor selection
Initial 30 days after last receipt of waste	Mobilization of contractor
Months 0-1 after beginning construction	Grading /preparation of intermediate cover
Months 1-4 after beginning construction	Placement of soil layer and/or flexible membrane liner, and soil protective layers
Months 4-5 after beginning construction	Installation of diversion berms and downslope pipes
Months 5-6 after beginning construction	Seed, fertilize and mulch

3.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Mark Anderson Taylor, being a registered Professional Engineer in the State of North Carolina, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this Closure Plan dated October 10, 2016 was conducted in accordance with the requirements of 40 C.F.R. § 257.102, is true and correct, and has been prepared in accordance with recognized and generally accepted good engineering practices.

SIGNATURE  DATE 10/10/16

Prepared by:

DUKE ENERGY.

BELEWS CREEK STEAM STATION
ACTIVE ASH BASIN

CLOSURE PLAN

OCTOBER 10, 2016

Certified by:

AECOM

6000 Fairview Road, Suite 200

Charlotte, NC 28210

Engineering Firm License Number: C-2243

BC_CLOSE_PLN

Rev. 0

Duke Energy Progress, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundment at the Belews Creek Steam Station (Belews Creek) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015) (CCR Rule). URS Corporation – North Carolina (AECOM) was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the Active Ash Basin (Ash Basin) located in Stokes County, North Carolina, on the property owned by Duke Energy. This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. A narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the CCR unit (as needed);
3. A description of the final cover system designed pursuant to 40 C.F.R. § 257.102(d), a description of the methods and procedures to be used to install the final cover, and a discussion of how the final cover system will achieve the performance standards specified in 40 C.F.R. § 257.102(d);
4. An estimate of the in-place CCR inventory requiring closure;
5. An estimate of the largest area of the CCR unit requiring a final cover;
6. A closure schedule; and
7. A written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps necessary to close the Ash Basin consistent with recognized and generally accepted good engineering practices. Closure is designed to reduce the need for long-term maintenance, control the post-closure infiltration of liquids into the in-place CCR materials, and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

Although, on May 18, 2016, the North Carolina Department of Environmental Quality (NCDEQ) ranked the Ash Basin "intermediate-risk," which would require it to be dewatered and excavated pursuant to the North Carolina Coal Ash Management Act of 2014, as amended (CAMA), Duke Energy is in the process of establishing the permanent replacement water supplies required under N.C.G.S. § 130A-309.211(c1) and performing the applicable dam safety repair work required under Dam Safety Order 16-01 issued by the state of North Carolina pursuant to the North Carolina Dam Safety Law of 1967, specifically N.C.G.S. § 143-215.32. Pursuant to N.C.G.S. § 130A-309.213(d)(1), upon Duke Energy's completion of these tasks within the required time frame set forth in CAMA, NCDEQ must classify the Ash Basin as low-risk, which will allow closure either pursuant to 40 C.F.R. § 257.102(c) or (d). Although CAMA charges NCDEQ with making the final determination regarding closure method, because science supports closure of the Ash Basin by leaving the CCR in place, Duke Energy contemplates that the Ash Basin will be closed in pursuant to the requirements of 40 C.F.R. § 257.102(d).

The method to close the Ash Basin in place will include: removal and treatment of the bulk water/free liquids; interstitial/pore dewatering (as needed) and treatment; stabilization of remaining CCR materials sufficient to support the final cover system; grading of in-place CCR materials to promote positive drainage (no ponding) and prevent sloughing or movement of the final cover system; installation of a final cover system, including stormwater management controls; partial lowering of the dam; and post-closure groundwater monitoring and cover system maintenance. The final cover system will be designed to reduce infiltration; erosion; and meet, or exceed, the requirements of the final cover system specified in 40 C.F.R. § 257.102(d)(3)(i). Typically, this involves the installation of a low permeability barrier layer and a vegetated soil cover to protect the barrier layer. The existing embankments will be lowered pursuant to a NCDEQ Dam Safety permit approval. This lowering is intended to promote free drainage of stormwater from the closure area.

2 CCR REMOVAL AND DECONTAMINATION

There may be some areas, primarily located around the perimeter of the Ash Basin, where closure-by-removal is selected in order to enhance surface drainage and/or to allow for development of future plant infrastructure or transmission. In-place CCR in those areas will typically be dewatered (if needed), excavated, and consolidated (placed) into the remaining portion of the basin, which will be graded and closed-in-place pursuant to 40 C.F.R. § 257.102(d).

Existing appurtenant structures, such as ditches, culverts and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed in a permitted disposal facility, or removed and placed in a beneficial use facility identified at the time of closure. Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 FINAL COVER REQUIREMENTS

The final cover system for in-place closure of the Ash Basin will be designed pursuant to 40 C.F.R. § 257.102(d). Closure of the Ash Basin will be conducted in a manner that controls, minimizes, or eliminates, to the maximum extent feasible, the post-closure infiltration of liquids into the CCR and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

The final cover system being considered is a composite (soil and geosynthetics) cover system consisting of (from top to bottom):

- A six-inch layer of soil that is capable of sustaining native plant growth;
- An 18-inch thick protective soil cover layer;
- A geocomposite drainage layer or non-woven geotextile; and
- A 40-mil thick linear low-density polyethylene geomembrane barrier.

Alternative final cover systems are also under evaluation that would meet, or exceed, the requirements specified in 40 C.F.R. § 257.102(d)(3)(ii), which make use of the latest developments in final cover technology. The final cover system will serve to minimize erosion and post-closure maintenance. Various stormwater control measures (e.g., diversion berms, channels, downslope pipes, and/or downchutes) will convey surface run-off from the cover, then to sediment basins (as appropriate), prior to discharge until the site is stabilized by vegetation. The design of the stormwater conveyances will include armoring and energy dissipation measures, as necessary, to control erosion and minimize maintenance and repairs.

The final cover system, with an equivalent (or lower) permeability of any bottom liner system or natural subsoils present, or a permeability no greater than $1x10^{-5}$ centimeters/second, will be constructed and maintained to minimize the infiltration of precipitation. By minimizing infiltration, the final cover will reduce leachate generation. The final cover system will be graded to preclude the probability of future impoundment of water, sediment, or slurry.

The Ash Basin will be closed in a manner resulting in stable slopes that prevent the sloughing or movement of the final cover system. The grades of the final cover system will be generally slight, sufficient to promote run-off while reducing the potential for sloughing. Instability potential (sliding or sloughing) is further reduced through the selection and use of cover system materials that have adequate drainage properties and sufficient internal and interface shear strengths. Construction quality assurance procedures will be completed to confirm conformance of the installed final cover system to the design.

Upon commencement of closure of the Ash Basin, final closure is anticipated to be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices. Section 6, Closure Schedule, of this Closure Plan describes the estimated time frames.

3.1 FINAL COVER SYSTEM

Pursuant to 40 C.F.R. § 257.102(d)(3)(i)(A) through (D), the final cover system will be designed and constructed to meet, at a minimum, the following criteria:

(A) The permeability of the final cover system will be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} centimeters/second, whichever is less.

The final cover system options being considered for the Ash Basin will meet or exceed this criteria. The geomembrane by itself results in a lower effective infiltration rate than the required 18 inches of $1x10^{-5}$ centimeters/second soil standard.

(B) The infiltration of liquids through the Ash Basin will be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

The geomembrane component of the final cover system results in equivalent or better infiltration performance than 18 inches of earthen material. The proposed protective cover (18 inches) and vegetative layer soil will be obtained from local borrow sites and/or portions of the dams and dikes that will be lowered during closure. The gradation of the soil used in the cover will be such that it does not damage the geomembrane, provides drainage, resists erosion, and supports plant growth.

(C) The erosion of the final cover system will be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

The materials proposed for the vegetative support layer in the composite cover system option, or the protective cover component of an alternate final cover system, will provide equivalent or better performance than a six-inch-thick erosion layer. In addition, prior to the completion of closure, stormwater run-off and wastewater generated from areas outside the Ash Basin drainage catchment (which had previously been routed through the basin when it was active) will be permanently diverted for treatment (as needed) and discharge at other locations within the site.

(D) The disruption of the integrity of the final cover system will be minimized through a design that accommodates settling and subsidence.

The materials proposed for the final cover systems will accommodate the amount of settlement and subsidence that is anticipated to be encountered during construction and post-closure. In addition, the cover grades and stormwater conveyance system grades will be designed to accommodate settlement during construction and post-closure care.

The methods and procedures used to install the final cover will include:

1. Completing necessary field characterizations and design analyses;
2. Obtaining necessary federal, state, and local permits;
3. Preparing bid documents and selecting a qualified contractor;
4. Mobilizing;
5. Installing erosion and sediment control measures;
6. Removing and treating (as needed) the bulk water/free liquid;
7. Decontaminating and abandoning in place, or removing the appurtenant structures within the Ash Basin;
8. Clearing and grubbing;
9. Constructing laydown areas and access roads;
10. Interstitial/pore dewatering and treatment (as needed);
11. Grading CCR materials to achieve design cover system subgrade elevations;

12. Installing the cover system and associated stormwater management controls;
13. Stabilizing the site with appropriate vegetation and final erosion and sediment control measures;
14. Lowering of the dam; and
15. Commencing post-closure maintenance and monitoring of the site.

3.2 DRAINAGE AND STABILIZATION

Bulk water/free liquids will be removed from the Ash Basin during the initial phases of construction. Interstitial/pore water may be removed and treated during construction as needed to provide a workable surface for final cover system installation. With the diversion of wastewater and the stormwater discharged to the basin from other locations on the site, the volume of interstitial/pore water within the basin is expected to further decline over time. The dam will be lowered following the final phase of cover system installation. Combined, these measures (diversion of wastewater and stormwater, bulk dewatering, selective interstitial/pore dewatering, cover system installation, and dam lowering) will stabilize the CCR materials sufficiently to support the final cover system.

4 ESTIMATE OF IN-PLACE CCR INVENTORY

The volume of CCR present in the Ash Basin was calculated and is presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volume is the estimated inventory of CCR that will be open (and require closure) at one time, and the estimate is based on bathymetric surveys, historical topography, and soil borings as of June 2014. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basin.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
Active Ash Basin	9,859,304

5 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

Closure of the Ash Basin will be accomplished by leaving CCR in place pursuant to 40 C.F.R. § 257.102(d). The largest area of the CCR units that will be open (and requiring a final cover) at one time is estimated to be 273 acres.

6 CLOSURE SCHEDULE

Closure of the Ash Basin will be initiated pursuant to 40 C.F.R. § 257.102(e) and is anticipated to be completed within nine years of the commencement of closure activities. The closure time frame includes two two-year time extension beyond the time specified in 40 C.F.R. §

257.102(f)(1)(ii) on the basis that the anticipated time required to close the Ash Basin will need to be lengthened due to:

- The Ash Basin being larger than 40 acres (estimated 273 acres);
- The amount of material needed to close the Ash Basin (estimated to be about 911,300 cubic yards of protective soil cover and vegetative cover material will be obtained from the dam and on-site borrow sources);
- The volume of CCR material (about 2 million cubic yards will need to be excavated and placed as grading fill);
- The volume of bulk water/free liquid to dewater (about 900 million gallons);
- The surrounding geology (the on-site soil borrow area is separated from the Ash Basin by a local highway, the need to process soils to remove rock that could damage geomembrane, etc.); and
- The time required, after the removal of bulk liquids, for the surface of the basin to stabilize to the point that personnel and equipment can safely access the impoundment. Given the site-specific geometry and physical characteristics of the CCR in the impoundment, the rate at which the materials will drain will likely be slow and variable. As a result, installation of instrumentation and monitoring equipment may be necessary in some instances to ensure subgrade stability is adequate, and other measures may need to be employed to stabilize the surface of the impoundment (possibly including closely-spaced well points, deep wells, trenches, etc.) in a timely manner.

The completed demonstration establishing why it is not feasible to complete closure of the Ash Basin within the five-year time frame due to factors beyond the facility's control will be prepared and placed in the facility's operating record prior to the end of any two-year period pursuant to 40 C.F.R. § 257.102(f)(2).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure, and are anticipated to include permits from NCDEQ and the U.S. Army Corps of Engineers. Preliminary time frames for anticipated closure activities are included below in Table 2. We estimate that all closure activities will be completed by 2028.

Table 2. Estimated Time Frames for Closure Activities

Closure Activity	Time Frame (years)*
NCDEQ Closure Plan Approval	1
NCDEQ Permitting Approvals (NDPES, E&SC, Air)	1
Dewatering and Stabilization	4
NCDEQ Dam Decommissioning Approval	0.5
CCR Grading	2
Final Cover Installation	6.5

*Estimated closure activity time frames may include some overlap.

7 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Ramachandran Kulasingam, being a registered Professional Engineer in the state of North Carolina, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this written Closure Plan dated October 10, 2016, was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared in accordance with recognized and generally accepted good engineering practices.

SIGNATURE R. Kulasingam DATE 10/10/2016

CLOSURE PLAN

CRAIG ROAD LANDFILL
BC_CRL_CLOSE_LDFL_PLN

DUKE ENERGY – BELEWS CREEK STEAM STATION

BELEWS CREEK, NORTH CAROLINA

Prepared for

DUKE ENERGY®

Duke Energy
550 South Tryon Street
Charlotte, North Carolina 28202

October 10, 2016

TABLE OF CONTENTS

1.0 INTRODUCTION

This Closure Plan was prepared for the Belews Creek Steam Station (BCSS) Craig Road Landfill. This Closure Plan was prepared in accordance with 40 C.F.R. Part 257, Subpart D and is consistent with the requirements of 40 C.F.R. § 257.102(b) for closure of coal combustion residuals landfills. The information contained in this Closure Plan will be used to assist Duke Energy Carolinas, LLC (Duke Energy) in the closure of active waste units. The BCSS Craig Road Landfill is owned and operated by Duke Energy. The landfill is located in Stokes County, North Carolina on Duke Energy property, south of the Belews Creek Steam Plant, between the east and west arms of Belews Creek Lake near Walnut Cove. Duke Energy must obtain a written certification from a qualified professional engineer, licensed in the state in which the project work is conducted, that this written Closure Plan and any amendments thereto meet the requirements of 40 C.F.R. § 257.102.

2.0 CLOSURE PLAN

2.1 Overview of Closure Approach

The purpose of the Closure Plan is to outline the sequence for closing the landfill phases consistent with recognized and generally accepted good engineering practices. Closure is designed to minimize the need for long term maintenance and to control the post-closure release of contaminants. The facility will be closed in accordance with the requirements of 40 C.F.R. § 257.102. Closure will occur within the time frames set out in 40 C.F.R. § 257.102(f). This Closure Plan may be amended in accordance with the requirements of 40 C.F.R. § 257.102(b)(3).

2.2 Estimated Maximum Inventory of CCR

As stated in the facility's solid waste permit, the gross capacity of the constructed Phases 1 and 2 is approximately 6,322,000 cubic yards as measured from the top of the protective cover soil to the top of final cover. The current landfill design for Phases 1 through 6 provides approximately 24,622,000 cubic yards of total gross capacity.

2.3 Largest Area Requiring Cover System

As stated in the facility's solid waste permit, the largest area that will need to be capped is the 156 acres making up Phases 1 through 6. Currently, only the 66 acres of Phases 1 and 2 is constructed.

2.4 Closure Performance Standard

2.4.1 Final Cover

The cover system has been designed to reduce infiltration into the landfill and to resist erosion, and to meet the requirements of 40 C.F.R. § 257.102(d)(3)(i). The permeability of the least permeable layer (a polyethylene geomembrane) is on the order of 10^{-12} cm/s. This is equal to or less than the permeability of the polyethylene geomembrane in the bottom liner system and no greater than 1×10^{-5} cm/sec.

The final cover system for the closed phase will be certified by a professional engineer as being designed in accordance with the requirements of 40 C.F.R. § 257.102.

With the type of waste that has been landfilled and the controlled nature of the fill placement, no decomposition of the waste material is expected, therefore minimum, if any, settlement is expected. Due to the high allowable strain of the geomembrane and the stable nature of the waste, the final cover system will accommodate any differential settlement that may occur in the waste during the post closure care period.

The proposed final cover system will consist of the following from top to bottom and will be placed over the existing intermediate soil cover:

- a 6-inch thick vegetative soil cover
- an 18-inch thick final soil cover
- a geocomposite drainage layer
- a 40-mil double-sided textured linear low density polyethylene (LLDPE) geomembrane

2.4.2 Alternate Final Cover

The alternate final cover system will consist of the following from top to bottom and will be placed over the existing intermediate soil cover:

- a 6-inch thick vegetative soil cover
- an 18-inch thick final soil cover
- an 8 oz/sy non-woven geotextile
- a 50-mil LLDPE structured geomembrane

2.4.3 Performance Standards

Closure of the facility will be conducted in a manner that minimizes the need for further maintenance and controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, the post-closure escape of uncontrolled leachate, surface runoff, or waste decomposition products to the groundwater, surface water, or the atmosphere.

The final cover system consisting of a vegetated soil layer with run-on and run-off controls will minimize the need for post-closure maintenance. The final slopes of the landfill will promote runoff. Diversion berms and downslope pipes will convey surface runoff to conveyances with non-erodible linings or, if applicable, to sediment basins designed for removal of sediment prior to discharge. A hardy stand of vegetation will be established and, along with the diversion berms and storm water conveyance channels, will minimize erosion of the final cover system.

A low-permeability final cover system will be constructed and maintained that minimizes the infiltration of precipitation into the waste mass. By minimizing infiltration, the final cover will minimize leachate generation.

The final slopes of the landfill will be five percent or greater to prevent ponding.

2.4.4 Stability

The CCR unit will be closed in a manner that provide for slope stability to prevent the sloughing or movement of the final cover system. In order to maintain stable slopes for the final cover, the internal and interface friction angles of all the components must be greater than the slope angle by a margin called a factor of safety. Since the maximum regulatory slopes are 3:1, only materials with friction angles greater than 26.6° will be used, providing a minimum factor of safety of 1.5. To ensure the stability of the vegetative support layer in the final cover system, adequate drainage must be provided to prevent the soil from becoming saturated and subject to seepage forces.

A seismic analysis was also performed and meets the requirements for stability in accordance with 40 C.F.R. § 257.63.

2.4.5 Closure Time Frame

The final cover system will be finished within six months following the beginning of closure construction unless otherwise approved. If more than six months are necessary, steps to prevent threats to human health and the environment from the unclosed landfill unit will be undertaken.

2.5 Schedule

In accordance with 40 C.F.R. § 257.102(e), the facility will begin closure activities within 30 days after final receipt of waste, or if the landfill has remaining capacity and there is a reasonable likelihood that the landfill will receive additional wastes, no later than two years after the most recent receipt of wastes. Contractor mobilization will occur during the initial 30 day period after last receipt of waste.

In accordance with 40 C.F.R. § 257.102(f)(1), the final cover system will be completed within six months following the beginning of closure construction unless a deadline extension is approved.

In accordance with 40 C.F.R. § 257.102(g), no later than the date on which closure of the CCR unit is initiated, prepare a notification of intent to close the unit, which includes the certification

by a qualified professional engineer for the design of the final cover system required by § 257.102(d)(3)(iii).

In accordance with 40 C.F.R. § 257.102(h), within 30 days of completion of closure, Duke Energy shall record a notation on the deed to the landfill property stating that the property has been used as a landfill and its use is restricted under the Closure/Post-Closure Plan and the post-closure care requirements as provided by 40 C.F.R. § 257.104(d)(1)(iii).

Within 30 days of recording the notation, Duke Energy shall prepare a notification stating that that the notation has been recorded and placed it into the facility's operating record. Pursuant to 40 C.F.R. § 257.106(d), Duke Energy shall send to the appropriate regulatory agency the notification of intent to close, notification of closure completion, and notification of deed notation, within 30 days of placing each such notification in the operating record.

An expected schedule for closure activities is as follows:

Time	Activity
Prior to last receipt of waste	Permitting, detailed closure design and contractor selection
Initial 30 days after last receipt of waste	Mobilization of contractor
Months 0-1 after beginning construction	Grading /preparation of intermediate cover
Months 1-4 after beginning construction	Placement of soil layer and/or flexible membrane liner, and soil protective layers
Months 4-5 after beginning construction	Installation of diversion berms and downslope pipes
Months 5-6 after beginning construction	Seed, fertilize and mulch

3.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Martin A. Shumpert, being a registered Professional Engineer, in accordance with the North Carolina Professional Engineer's Registration, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this plan dated October 10, 2016, was prepared in accordance with the requirements of 40 C.F.R. § 257.102, is true and correct, and has been prepared in accordance with recognized and generally accepted good engineering practices.

Prepared for:
DUKE ENERGY

Belews Creek Steam Station
3195 Pine Hall Rd.
Belews Creek, NC 27009

BELEWS CREEK STEAM STATION
FGD RESIDUE LANDFILL

CLOSURE PLAN

October 2016

NORTH CAROLINA PROFESSIONAL SEAL 034412 ENGINEER AMY R. RYDER
10/10/16

Prepared by:
JOYCE ENGINEERING
9731-F Southern Pine Blvd
Charlotte, North Carolina 28273
Phone: 704.817.2037
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JOYCE Project: 845.1502.11 Task 01

1.0 INTRODUCTION

This Closure Plan was prepared for the Belews Creek Steam Station (BCSS) – Flue Gas Desulfurization (FGD) Residue Landfill. This Closure Plan was prepared in accordance with 40 C.F.R. Part 257, Subpart D and is consistent with the requirements of 40 C.F.R. § 257.102(b) for closure of coal combustion residuals landfills. The information contained in this Closure Plan will be used to assist Duke Energy Carolinas, LLC (Duke Energy) in the closure of active waste units. The BCSS FGD Landfill is owned and operated by Duke Energy. The landfill is located in Stokes County, North Carolina on Duke property, south of BCSS, between the east and west arms of Belews Creek Lake near Walnut Cove. Duke Energy must obtain a written certification from a qualified professional engineer, licensed in the state in which the project work is conducted, that this written Closure Plan and any amendments thereto meet the requirements of 40 C.F.R. § 257.102.

2.0 CLOSURE PLAN

2.1 Overview of Closure Approach

The purpose of the Closure Plan is to outline the steps necessary to close the landfill phases consistent with recognized and generally accepted good engineering practices. Closure is designed to minimize the need for long-term maintenance and to control the post-closure release of contaminants. The facility will be closed in accordance with the requirements of 40 C.F.R. § 257.102. Closure will occur within the time frames set out in 40 C.F.R. § 257.102(f). This Closure Plan may be amended in accordance with the requirements of 40 C.F.R. § 257.102(b)(3).

2.2 Estimated Maximum Inventory of CCR

The current landfill design provides approximately 1,500,000 cubic yards of gross capacity as measured from the top of the protective cover soil to the top of final cover.

2.3 Largest Area Requiring Cover System

The Phase 1 permitted area of 22.6 acres is currently the largest area that will need to be capped.

2.4 Closure Performance Standard

2.4.1 Final Cover System

The cover system has been designed to reduce infiltration into the landfill and to resist erosion. The permeability of the least permeable layer is 1×10^{-12} cm/sec. This is equal to or less than the permeability of the bottom liner system and no greater than 1×10^{-5} cm/sec.

The final cover system for the closed phase will be certified by a qualified professional engineer as being designed in accordance with the requirements of 40 C.F.R. § 257.102.

With the type of waste that has been landfilled and the controlled nature of the fill placement, no decomposition of the waste material is expected, therefore minimum, if any, settlement is expected. Due to the high allowable strain of the geomembrane and the stable nature of the waste, the final cover system will accommodate any differential settlement that may occur in the waste during the post closure care period.

The proposed final cover system will consist of the following from top to bottom and will be placed over the existing intermediate soil cover:

- a 6-inch thick vegetated erosion layer;
- a 18-inch thick soil barrier;
- a geocomposite drainage layer;
- a 40-mil thick double-sided textured linear low density polyethylene (LLDPE) geomembrane; and
- a geocomposite layer.

2.4.2 Alternate Final Cover System (Not Applicable)

2.4.3 Performance Standards

Closure of the facility will be conducted in a manner that minimizes the need for further maintenance and controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, the post-closure escape of uncontrolled leachate, surface runoff, or waste decomposition products to the groundwater, surface water, or the atmosphere.

The final cover system consisting of a vegetated soil layer with run-on and run-off controls will minimize the need for post-closure maintenance. The final slopes of the landfill will promote runoff. Diversion berms and downslope pipes will convey surface runoff to sediment basins designed for removal of sediment prior to discharge. A hardy stand of vegetation will be established and, along with the diversion berms and storm water conveyance channels, will minimize erosion of the final cover system.

A low-permeability final cover system will be constructed and maintained that minimizes the infiltration of precipitation into the waste mass. By minimizing infiltration, the final cover will minimize leachate generation.

The final slopes of the landfill will not be less than five percent to prevent ponding.

The CCR unit will be closed in a manner that provides for slope stability to prevent the sloughing or movement of the final cover system. In order to maintain stable slopes for the final cover, the internal and interface friction angle of all the components must be greater than the slope angle by a margin called the factor of safety. For this final cover system, a factor of safety of 1.5 is provided. To ensure the stability of the vegetative support layer in the final cover system, adequate drainage must be provided to prevent the soil from becoming saturated and subject to seepage forces.

An analysis was also performed to demonstrate the stability of proposed cap section during seismic conditions. An acceptable factor of safety is 1.0 or greater to guard

against slope failure. The analysis was performed in accordance with the requirements of 40 C.F.R. § 257.63 and the seismic factor of safety was found to be greater than 1.0.

The final cover system will be finished within six months following the beginning of closure construction unless otherwise approved. If more than six months are necessary, steps to prevent threats to human health and the environment from the unclosed landfill unit will be undertaken.

2.5 Schedule

In accordance with 40 C.F.R. § 257.102(e), the facility will begin closure activities within 30 days after the known final receipt of waste, or if the landfill has remaining capacity and there is a reasonable likelihood that the landfill will receive additional wastes, no later than two years after the most recent receipt of wastes. Contractor mobilization will occur during the initial 30-day period after last known receipt of waste.

In accordance with 40 C.F.R. § 257.102(g), no later than the date on which closure of the CCR unit is initiated, prepare a notification of intent to close the unit, which includes the certification by a qualified professional engineer for the design of the final cover system required by § 257.102(d)(3)(iii).

In accordance with 40 C.F.R. § 257.102(h), within 30 days following completion of closure of the CCR unit, Duke Energy shall record a notation on the deed to the landfill property stating that the property has been used as a landfill and its use is restricted under the Post-Closure Plan and the post-closure care requirements as provided by 40 C.F.R. § 257.104(d)(1)(iii).

Within 30 days of recording the notation, Duke Energy shall prepare a notification stating that that the notation has been recorded and placed it into the facility's operating record. Pursuant to 40 C.F.R. § 257.106(d), Duke Energy shall send to the appropriate regulatory agency the notification of intent to close, notification of closure completion, and notification of deed notation, within 30 days of placing each such notification in the operating record.

An expected schedule for closure activities is as follows:

Time	Activity
Prior to last receipt of waste	Permitting, detailed closure design and contractor selection
Initial 30 days after last receipt of waste	Mobilization of contractor
Months 0-1 after beginning construction	Grading /preparation of intermediate cover
Months 1-4 after beginning construction	Placement of soil layer and/or flexible membrane liner, and soil protective layers

Months 4-5 after beginning construction	Installation of diversion berms and downslope pipes
Months 5-6 after beginning construction	Seed, fertilize and mulch

3.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Amy Davis, being a registered Professional Engineer, in accordance with the North Carolina Professional Engineer's Registration do hereby certify to the best of my knowledge, information, and belief, that the information contained in this report dated August, 2016 was prepared in accordance with the requirements of 40 C.F.R. § 257.102, is true and correct, and has been prepared in accordance with recognized and generally accepted good engineering practices.

Prepared by:

DUKE ENERGY

BUCK STEAM STATION

ADDITIONAL PRIMARY POND (ASH BASIN 1)

PRIMARY POND (ASH BASIN 2)

SECONDARY POND (ASH BASIN 3)

CLOSURE PLAN

OCTOBER 7, 2016

Certified by:

HDR

HDR Engineering, Inc. of the Carolinas

440 S. Church Street, Suite 1000

Charlotte, NC 28202

N.C.B.E.L.S. License Number F-0116

BUC_CLOSE_PLN

Rev. 0

Duke Energy Carolinas, LLC (Duke Energy) prepared this Closure Plan for the Coal Combustion Residuals (CCR) surface impoundments at the Buck Steam Station (Buck) pursuant to the requirements of 40 C.F.R. § 257.102(b) of the Disposal of CCR from Electric Utilities rule, 80 Fed. Reg. 21302 (April 17, 2015). HDR Engineering, Inc. of the Carolinas (HDR) was retained by Duke Energy to certify that this Closure Plan meets the requirements of 40 C.F.R. § 257.102. The information contained in this Closure Plan will be used to assist Duke Energy in the closure of the Additional Primary Pond (Ash Basin 1), Primary Pond (Ash Basin 2), and Secondary Pond (Ash Basin 3) (collectively, Ash Basins) located in Rowan County, North Carolina, on property owned by Duke Energy. This Closure Plan may be amended pursuant to the requirements of 40 C.F.R. § 257.102(b)(3). Presented below are:

1. A narrative of closure activities;
2. A description of the procedures to remove CCR and decontaminate the CCR units;
3. An estimate of the in-place CCR inventory requiring closure;
4. An estimate of the largest area of the CCR units requiring a final cover (as needed);
5. A closure schedule; and
6. A written certification from a qualified professional engineer, licensed in North Carolina, that this Closure Plan meets the requirements of 40 C.F.R. § 257.102.

1 NARRATIVE OF CLOSURE ACTIVITIES

The purpose of this Closure Plan is to describe the steps necessary to close the Ash Basins consistent with recognized and generally accepted good engineering practices. Closure is designed to reduce the need for long-term maintenance, and control the post-closure release of constituents into environmental pathways (i.e., air, surface water, and groundwater).

The Ash Basins will be closed by removal of CCR pursuant to 40 C.F.R. § 257.102(c). Duke Energy will use commercially reasonable efforts to process the CCR removed from the Ash Basins at an on-site CCR beneficiation facility processing 300,000 tons of CCR annually pursuant to North Carolina General Statutes (N.C.G.S) § 130A-309.216, as enacted by Section 1 of House Bill 630, Session Law 2016-95. To the extent there is any remaining CCR in the Ash Basins after beneficiation operations have permanently ceased at Buck, the CCR will be moved to a permitted disposal facility. Procedures for CCR removal and decontamination are described in the following section.

2 CCR REMOVAL AND DECONTAMINATION

The procedures to remove CCR from the Ash Basins include dewatering and utilizing appropriate equipment and methods to excavate and process the CCR at an on-site CCR beneficiation facility pursuant to N.C.G.S. § 130A-309.216, and, to the extent required, move any remaining CCR to a permitted disposal facility. Dewatering will include removal of bulk water/free liquids and interstitial/pore water (as needed) to allow for safe excavation.

Select dams will be breached pursuant to a North Carolina Department of Environmental Quality (NCDEQ) Dam Safety permit approval. These breaches are intended to promote free drainage of storm water from the closure area.

Existing appurtenant structures, such as ditches, culverts, and miscellaneous piping, will be decontaminated and abandoned in place, removed and disposed in a permitted disposal facility, or removed and placed in a beneficial use facility identified at the time of closure. Decontamination procedures may consist of pressure washing, scrubbing, or other generally accepted decontamination procedures.

Pursuant to 40 C.F.R. § 257.102(c), closure will be complete when groundwater monitoring concentrations do not exceed the applicable groundwater protection standard established pursuant to 40 C.F.R. § 257.95(h) for constituents listed in appendix IV to 40 C.F.R. Part 257.

3 ESTIMATE OF IN-PLACE CCR INVENTORY

The estimated volumes of CCR present in the Ash Basins were calculated and are presented in Table 1 below, pursuant to 40 C.F.R. § 257.102(b)(1)(iv). The volumes are the estimated inventory of CCR that will be open (and require closure) at one time and are based on bathymetric surveys, historical topography, and soil borings as of July 2015. The annual surface impoundment inspections completed, pursuant to 40 C.F.R. § 257.83(b), and posted to the Duke Energy CCR website, pursuant to 40 C.F.R. § 257.107(g)(5), contain the most recent estimates of CCR material in the Ash Basins.

Table 1. Estimated In-Place CCR Inventory

Basin	Quantity of CCR (cubic yards)
Additional Primary Pond (Ash Basin 1)	3,155,000
Primary Pond (Ash Basin 2)	1,665,000
Secondary Pond (Ash Basin 3)	720,000
Estimated Total	**5,540,000**

4 ESTIMATE OF LARGEST AREA REQUIRING FINAL COVER

CCR will be removed from the Ash Basins pursuant to 40 C.F.R. § 257.102(c); therefore, no final cover system will be constructed in support of closure activities.

5 CLOSURE SCHEDULE

Closure of the Ash Basins will be initiated pursuant to 40 C.F.R. § 257.102(e)(1)(ii) and is anticipated to be completed within five years of the completion of processing CCR for beneficial use pursuant to 40 C.F.R. § 257.102(f)(1)(ii).

Prior to commencing closure construction, design documents will be prepared to support applications for required local, state, and federal permits. Closure construction design

documents will include construction drawings, technical specifications, and quality assurance testing work plans. The permits required for closure construction activities will be evaluated at the time of closure and are anticipated to include permits from NCDEQ, the U.S. Army Corps of Engineers, and the Federal Energy Regulatory Commission. Preliminary time frames of anticipated closure activities for the Ash Basins are included below in Table 2. Duke Energy estimates that the processing of CCR for beneficial use and the closure activities for the Ash Basins will be completed by 2029.

Table 2. Estimated Time Frames for Closure Activities

Closure Activity	Time Frame (years)*
NCDEQ Closure Plan Approval	1
NCDEQ Permitting Approvals (NPDES, E&SC, Air)	1
Dewatering and Stabilization	2
NCDEQ Dam Decommissioning Approval	0.5
CCR Excavation	2

*Estimated closure activity time frames may include some overlap and do not include beneficial use activities.

6 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Thomas M. Yanoschak, being a registered Professional Engineer in the state of North Carolina, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this written Closure Plan dated October 10, 2016, was developed pursuant to the requirements of 40 C.F.R. § 257.102 and has been prepared consistent with recognized and generally accepted good engineering practices.

NORTH CAROLINA PROFESSIONAL SEAL 18887 ENGINEER THOMAS M. YANOSCHAK

SIGNATURE Thomas M. Yanoschak DATE 10/7/16